QUALITY ASSURANCE ADDENDUM

QAA 2.2

to the

ROCKY FLATS PLANT SITE-WIDE QA PROJECT PLAN

FOR CERCLA RI/FS AND RCRA RFI/CMS ACTIVITIES

for

OPERABLE UNIT NO. 2 (BEDROCK), 903 PAD, MOUND, AND EAST TRENCHES AREAS

PHASE II RFI/RI

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PHASE II RFI/RI

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

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INTRODUCTION AND SCOPE

This Quality Assurance Addendum (QAA) supplements the "Rocky Flats Plant Site-Wide Quality Assurance Project Plan for CERCLA RI/FS and RCRA RFI/CMS Activities" (QAPjP) for bedrock field investigation activities described in the Phase II RFI/RI Bedrock Workplan for 903 Pad, Mound, and East Trenches Areas (Operable Unit [OU] No 2) dated January 1991 (OU-2 Bedrock Workplan)

1 0 ORGANIZATION AND RESPONSIBILITIES

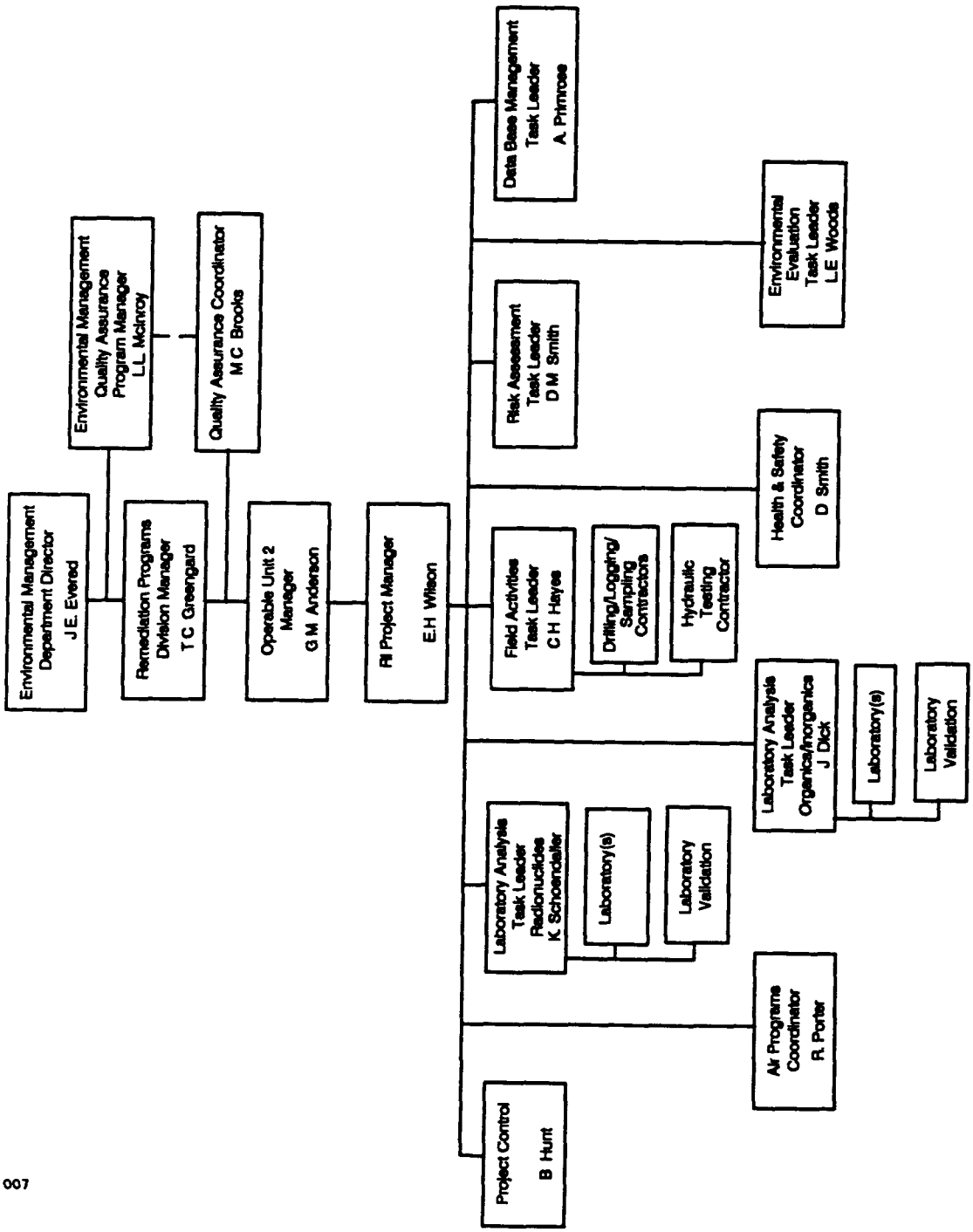
The overall organization of EG&G Rocky Flats and the Environmental Restoration (ER) Department divisions involved in ER activities is shown in Section 1 of the QAPjP Specific responsibilities are also described in detail in Section 1 of the QAPjP

Contractors will be tasked by the EG&G ER Department personnel to implement the OU-2 Phase II investigations identified in the OU-2 Bedrock Workplan The specific ER Department personnel who will interface with the Contractors and who will be authorized to provide technical direction are shown in Figure 1

2 0 QUALITY ASSURANCE PROGRAM

The QAPjP was written to specifically address QA controls for Interagency Agreement (IAG) related activities The content of the QAPjP was driven by DOE RFP SOP 5700 6B, which requires that a QA program be implemented for all Rocky Flats Plant (RFP) activities based on ASME NQA-1, "Quality Assurance Requirements for Nuclear Facilities," as well as the IAG, which specifies that a QAPjP for IAG-related activities be developed in accordance with EPA QAMS-005/80, "Interim Guidelines and Specifications for Preparing QAPjPs " The 18-element format of NQA-1 was selected as the basis for both the plan and subsequent QAAs with the applicable elements of EPA QAMS-005/80 incorporated where appropriate

FIGURE 1. PROJECT MANAGEMENT FOR OPERABLE UNIT 2 (BEDROCK), 903 PAD, MOUND, EAST TRENCHES, PHASE II RFI/RI



The QA controls and requirements addressed in the QAPjP are applicable to OU-2 Bedrock Workplan activities, unless otherwise specified in this QAA As a supplement to the QAPjP, this QAA addresses additional and site-specific QA controls and requirements that are applicable to OU-2 Bedrock Phase II activities

2 1 Training

All personnel (including subcontractor personnel) shall complete the orientation and personnel training specified in Section 2 of the QAPjP Additional training is required for all personnel performing activities in accordance with the Standard Operating Procedures (SOPs) specified in this QAA Those personnel shall receive documented training in this QAA and the applicable SOPs prior to performing the work

3 0 DESIGN CONTROL AND CONTROL OF SCIENTIFIC INVESTIGATIONS

The OU-2 Bedrock Workplan is the design control plan for the Phase II RFI/RI OU-2 bedrock investigations The sampling rationale and investigation program, including sample locations, frequency, and analytical requirements, are discussed in the Field Sampling Plan (Section 8 0) of the OU-2 Bedrock Workplan and are summarized in this QAA The specific SOPs to be implemented by EG&G Rocky Flats and contractor personnel during all aspects of the field investigation are identified here The data quality objectives (DQOs) for the Phase II bedrock investigations are also identified in this QAA

The OU-2 Bedrock field investigations are designed to further delineate and characterize the physical nature of the bedrock units beneath the OU-2 areas, refine the bedrock groundwater model, characterize and delineate possible sources of contamination, and characterize the nature and extent of contamination of the bedrock groundwater system The site-specific objectives and data needs are discussed in Section 4 3 and listed in Table 4-1 of the OU-2 Bedrock Workplan In order to meet these objectives, the following activities will be performed

- Drilling and logging of borings,

- Collection of subsurface soil and bedrock samples for geotechnical and geochemical laboratory analysis,
- Installation and development of groundwater sampling/monitoring wells in bedrock boreholes,
- Collection and analysis of groundwater samples,
- Water level monitoring in wells, and
- In-situ hydraulic conductivity testing

3 1 Data Quality Objectives

3 1 1 Objectives

Table 4-1 of the OU-2 Bedrock Workplan lists the analytical levels that are appropriate for the RFI/RI objectives/data needs and data uses These analytical levels are discussed and described in Appendix A of the QAPjP Table A1 3 of the QAPjP (Appendix A) lists the data quality controls and types of analytical methods that are appropriate for the various analytical levels Based on these data quality controls and recommended analytical methods, the following DQOs for the OU-2 Bedrock Workplan investigations are established

Data quality controls for analytical level I activities (e g , drilling, borehole logging, conductivity testing, and water level monitoring) consist of adhering to specific field instrument calibration instructions and field monitoring/logging/testing SOPs Precision, accuracy, and completeness parameters are not applicable for analytical level I activities The precision, accuracy, and completeness parameters for levels II - V are discussed below, along with comparability and representativeness for all levels

3 1 2 Precision and Accuracy

The DQOs for precision and accuracy for the analytical methods referenced in the Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), which includes EPA CLP protocols and standard EPA methods when CLP protocols are unavailable, are included in Appendix B of the QAPjP Since the analytical program for OU-2, as specified in Table 8-2 of the OU-2 Bedrock Workplan, will utilize the analytical methods referenced in the GRRASP, the objectives for precision and accuracy presented in the QAPjP are applicable to the OU-2 Bedrock Phase II RFI/RI Those objectives are reproduced here in Appendix A

All of the parameters listed in the OU-2 Bedrock Workplan (Table 8-2) for the Phase II analytical program are addressed in the Analytical Methods Detection Limits, and DQO Table in Appendix A

3 1 3 Completeness

The target completeness objective for both field and analytical data for this project is 90 percent

3 1 4 Comparability

Comparability is a qualitative parameter that is ensured by implementation of the sampling and analysis plan, standardized analytical protocols, SOPs for field investigations, and by reporting data in uniform units as specified in the OU-2 Bedrock Workplan and SOPs

3 1 5 Representativeness

Representativeness is a qualitative parameter that is ensured through the careful development and review of the sampling and analysis strategy outlined in the OU-2 Bedrock Workplan and SOPs for sample collection and analysis and field data collection

3 2 Sampling Locations and Sampling Procedures

The design and rationale of the field investigations are described in the Field Sampling Plan presented in the OU-2 Bedrock Workplan (Section 8 0) Figure 8-2 of the OU-2 Bedrock Workplan demonstrates the scope and sequencing of subsequent steps of the investigation The location of proposed boreholes and well clusters, where subsurface soil, bedrock, and groundwater sampling will occur, are shown in Figure 8-1 of the OU-2 Bedrock Workplan The purpose and anticipated depth of each borehole and well are presented in Table 8-1 of the OU-2 Bedrock Workplan

The SOPs that are applicable to the OU-2 Bedrock Workplan field sampling program are listed in Table 1 Drilling and sampling of boreholes and wells will be done according to SOP 3 2, Drilling and Sampling Using Hollow-Stem Auger Techniques The lithology of all boreholes will be logged in accordance with SOP 3 1, Logging Alluvial and Bedrock Materials The bedrock will be isolated from the alluvium in all boreholes that encounter bedrock according to SOP 3 3, Isolating Bedrock from Alluvium with Grouted Surface Casing During drilling, soil and weathered and unweathered bedrock will be screened for volatile organic compounds by the headspace methods described in SOP 3 9, Soil Gas Sampling and Field Analysis, and the Addendum for SOP 3 9 described in Section 10 2 of the OU-2 Bedrock Workplan

Borehole hydraulic conductivity tests will be conducted in the central borehole of each of the borehole/well clusters shown in Figure 8-1 (OU-2 Workplan) according to SOP 2 3, Pump-In Borehole Packer Testing Boreholes that are not completed as wells for groundwater monitoring will be plugged according to SOP 3 5, Plugging and Abandonment of Boreholes Those boreholes that are completed for groundwater monitoring will be developed according to SOP 2 2

Groundwater measurements and sampling will be conducted according to SOPs 2 1, Water Level Measurements in Wells and Piezometers, according to SOP 2 5, Measurement for Groundwater Field Parameters, and 2 6, Groundwater Sampling At least one groundwater sample will be collected from each well for laboratory analysis of parameters listed in Table 8-2 of the OU-2 Bedrock Workplan Water level measurements will be taken monthly throughout the field investigation During groundwater sampling, a check for the presence of non-aqueous phase

TABLE 1
Standard Operating Procedures and Field Activities for Which They are Applicable

Standard Operating Procedures	Field Screening Survey	Well Drilling Completion	Groundwater Development Sampling	Surface-Water Sampling	Sediment Sampling	Surface Soil Sampling	Subsurface Soil/Rock Sampling	Source Sampling	Biota Sampling
1 1 Wind Blown Contaminant Dispersion Control		●					●		
1 2 Field Document Control	●	●	●	●	●	●	●	●	●
1 3 General Equipment Decontamination	●	●	●	●	●	●	●	●	●
1 4 Heavy Equipment Decontamination		●	●	●	●	●	●	●	●
1 5 Handling of Purge and Development Water		●	●						
1 6 Handling of Personal Protective Equipment	●	●	●	●	●	●	●	●	●
1 7 Handling of Decontamination Water & Wash Water	●	●	●	●	●	●	●	●	●
1 8 Handling of Drilling Fluids & Cuttings		●			●		●		
1 9 Handling of Residual Samples						●	●	●	●
1 10 Receiving Labeling and Handling Waste Containers		●	●				●	●	●
1 11 Field Communications	●	●	●	●	●	●	●	●	●
1 12 Decontamination Facility Operations	●	●	●	●	●	●	●	●	●
1 13 Containerizing Preserving Handling and Shipping of Soil and Water Samples			●	●	●	●	●	●	●
1 14 Field Data Management	●	●	●	●	●	●	●	●	●
1 15 Use of PIDs and FIDs		X	X	X	X	X	X	X	X
1 16 Field Radiological Measurements									
a) Walk-Over Surveys	●	X	X	X	X	X	X	X	X
b) Sample and Waste Screening		X	X	X	X	X	X	X	X

X As required by H&S plan

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TABLE 1 (Continued)
Standard Operating Procedures and Field Activities for Which They are Applicable

Standard Operating Procedures	Field Screening Survey	Well Drilling Completion	Ground-Water Development Sampling	Surface-Water Sediment Sampling	Surface Soil Sampling	Subsurface Soil/Media Sampling	Source Sampling	Blank Sampling
2 1 Water Level Measurements in Wells and Piezometers	●	●						
2 2 Well Development								
a) New Wells	●							
b) Redevelopment	●							
2 3 Pump-In Borehole Packer Tests	●	●						
2 5 Measurements for Groundwater Field Parameters		●						
2 6 Groundwater Sampling								
a) Bailer			●					
b) Pump			●					
3 1 Logging Alluvial and Bedrock Material	●					●		
3 2 Drilling and Sampling Using Hollow-Stem Auger Techniques								
a) Drilling	●					●		
b) Continous Auger Coring	●					●		
3 3 Isolating Bedrock from Alluvium with Grouted Surface Casing	●							
3 5 Plugging and Abandonment of Boreholes	●					●		
3 6 Monitoring Well and Piezometer Installation	●							
3 7 Logging of Test Pits and Trenches						●		
3 8 Surface Soil Sampling					●			
3 9 Soil Gas Sampling and Field Analysis	●							
3 10 Borehole Clearing						●		
3 11 Plugging and Abandonment of Wells	●							

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liquids in the well will be made per SOP 2 1 If detected, non-aqueous phase liquids will be sampled according to the Addendum to SOP 2 6 described in Section 10 1 of the OU-2 Bedrock Workplan

3 3 Analytical Procedures

The analytical program is discussed in Section 8 3 of the OU-2 Workplan The analytical methods for the analytes listed in Table 8-2 of the OU-2 Bedrock Workplan that shall be adhered to are those that are specified in the GRRASP Those methods are referenced in Section 3 of the QAPjP Specific analytical methods for each analyte are also referenced here in Appendix A

3 4 Physical Analysis

Physical analysis on soil and bedrock samples will consist of classification (ASTM D2488), moisture content (ASTM D2216), and dry density for intact samples (ASTM D2216) Laboratory classification tests will consist of grain size distribution (ASTM D422) and Atterberg limits (ASTM D4318) Laboratory classifications will be conducted for a minimum of 10 samples of each general bedrock material type

3 5 Equipment Decontamination

Non-dedicated sampling equipment shall be decontaminated between sampling locations in accordance with SOP 1 3, General Equipment Decontamination Other equipment (e g , heavy equipment) potentially contaminated during drilling, hydrogeologic/geologic testing, boring, sample collection, etc shall also be decontaminated as specified in SOP 1 4, Heavy Equipment Decontamination

3 6 Quality Control Checks

To assure the quality of the field sampling techniques, collection and/or preparation of field quality control (QC) samples are incorporated into the sampling scheme Field QC samples and collection frequencies for the field investigations are shown in Table 2

In addition, a QC sample, which will consist of an extra volume of a designated field sample, shall be collected at a 5 percent frequency for each specific sample matrix These QC samples shall be collected and submitted to the laboratory to allow for the analysis of laboratory-prepared QC samples to provide the laboratory with a check on its internal operations The volume required for the QC sample shall be double that of a normal sample A specific sampling schedule will be prepared by the sampling subcontractor for approval by the Laboratory Analysis Task Leaders (Figure 1) prior to sampling

3 6 1 Objectives for Field QC Samples

Equipment rinsate blanks are considered acceptable (with no need for data qualification) if the concentration of analytes of interest is less than three times the required detection limit for each analyte as specified in Appendix A Field duplicate samples shall agree within 30 percent relative percent difference for aqueous samples and 40 percent for homogenous, non-aqueous samples

Trip blanks and field preservation blanks (for organics and inorganics, respectively) indicate possible field contamination when analytes are detected above the minimum detection limits presented in Appendix A The Laboratory Analysis Task Leader (Figure 1) is responsible for verifying these criteria and is responsible for checking to see if they are met and for qualifying data

TABLE 2
FIELD QC SAMPLE COLLECTION FREQUENCY

Activity	Frequency
Field Duplicate	1 in 20[1]
Field Preservation Blanks[2]	1 sample per shipping container (or a minimum of 1 per 20 samples)
Trip Blank[3]	1 in 20
Equipment Rinsate Blank	1 in 20[4] or 1 per day, whichever is more frequent
Drilling and Decontamination Fluids	Sample source and analyze for all analytes of interest prior to use

1 Or per sampling event, whichever is more frequent
2 For groundwater samples to be analyzed for inorganics
3 For groundwater samples to be analyzed for volatile organics only
4 One equipment rinsate blank in twenty samples for each specific sample matrix being collected when non-dedicated equipment is being used

3 6 2 Laboratory QC

Laboratory QC procedures are used to provide measures of internal consistency of analytical and storage procedures The laboratory contractor will submit written SOPs to the Laboratory Analysis Task Leader for approval The laboratory QC procedures that will provide the basis for these SOPs are described in detail in the analytical methods cited in Appendix A At a minimum, these interlaboratory SOPs shall be consistent with or equivalent to EPA-CLP QC procedures Laboratory QC techniques for ensuring consistency and validity of analytical results (including detecting potential laboratory contamination of samples) include using reagent blanks, field blanks, internal standard reference materials, laboratory replicates, and field duplicates The laboratory contractor will follow the standard evaluation guidelines and QC procedures, including frequency of QC checks, that are applicable to the particular type of analytical method being used as specified in the GRRASP and Section 3 of the QAPjP All results will be forwarded to the Laboratory Analysis Task Leader and validation contractor (Figure 1) for review and verification

3 7 Data Reduction, Validation, and Reporting

3 7 1 Analytical Reporting Turnaround Times

Analytical reporting turnaround times are as specified in Table 3-1 of the QAPjP

3 7 2 Data Validation

Validation activities consist of reviewing and verifying field and laboratory data and evaluating the verified data for data quality (i e , comparison of reduced data to DQOs, where appropriate) The field and laboratory data validation activities and guidelines are described and referenced in Section 3 of the QAPjP The process for validating the quality of the data is illustrated graphically in Figure 3-1 of the QAPjP, and is also included as part of the sample collection, chain-of-custody, and analysis process illustrated in Figure 8-1 of the QAPjP The criteria for determining the validity of data are described in Section 3 of the QAPjP

3 7 3 Data Reduction

The reduction of field and laboratory data is described in Section 3 of the QAPjP All field and laboratory raw data sets shall be verified (as described above) and shall then be input into the RFEDS environmental database using a remote data entry module (see SOP 1 14, Database Management)

3 7 4 Data Reporting

Depending on the data validation process, data are flagged as either "valid," "acceptable with qualifications," or "rejected " The results of the data validation shall be reported in ER Department Data Assessment Summary reports The usability of data (the criteria of which is also described in Section 3 of the QAPjP) shall be addressed by the RI Project Manager

4 0 PROCUREMENT DOCUMENT CONTROL

Contractors will perform the field investigations described in the OU-2 Bedrock Workplan The Contractors will be required to implement all requirements contained in the Workplan, the QAPjP, this QAA, and all applicable SOPs referenced in these documents Analytical services will also be contracted for analysis of field samples Appropriate requirements from the QAPjP, this QAA, and the GRRASP shall be passed on to any organizations performing these analyses Contractors may also be utilized to validate analytical data packages Applicable requirements from this QAA shall be transmitted to the validation Contractor

The implementing Contractors will be required to provide the materials necessary for performing the work described in the OU-2 Bedrock Workplan

Contractors may be required to submit a QA Program that meets the applicable requirements of the QAPjP and this QAA

5 0 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

5 1 Workplans

The OU-2 Bedrock Workplan describes the Phase II RFI/RI investigations to be performed The plan will be reviewed and approved in accordance with the requirements for instructions, procedures, and drawings outlined in the QAPjP

5 2 Procedures

SOPs approved for use are identified in Table 1, which also indicates their applicability Any additional quality-affecting procedures proposed for use but not identified here will be developed and approved as required by the QAPjP prior to performing the affected activity

The OU-2 Bedrock Workplan includes SOP addenda for SOPs 2 6, Groundwater Sampling (the addendum addresses the detection and sampling of non-aqueous phase liquids) and 3 9, Soil Gas Sampling and Field Analysis

6 0 DOCUMENT CONTROL

The following documents will be controlled in accordance with the QAPjP

- Phase II RFI/RI Workplan (Bedrock) for 903 Pad, Mound, and East Trenches Areas (Operable Unit No 2),
- RFP Site-Wide Quality Assurance Project Plan for CERCLA RI/FS and RCRA RFI/CMS Activities (QAPjP),
- Quality Assurance Addendum to the Rocky Flats Site-Wide QAPjP for CERCLA RI/FS and RCRA RFI/CMS Activities for Operable Unit No 2, for 903 Pad, Mound, and East Trenches Areas (Bedrock) Phase II RFI/RI Activities,
- SOPs specified in Table 1 of this QAA and SOP Addendum specified in the OU-2 Bedrock Workplan

7 0 CONTROL OF PURCHASED ITEMS AND SERVICES

Contractors that provide services to support the OU-2 Workplan activities will be selected and evaluated as outlined in the QAPjP This includes preaward evaluation/audit of proposed Contractors as well as periodic audit of the acceptability of Contractor performance during the life of the contract Such audits shall be performed at least annually or once during the life of the project, whichever is more frequent Also see Section 18 0 of the QAPjP

8 0 IDENTIFICATION AND CONTROL OF ITEMS, SAMPLES, AND DATA

8 1 Sample Containers/Preservation

Appropriate volumes, containers, preservation requirements, and holding times for all ER Program soil and water matrix samples are presented in Tables 8-1 through 8-4 of the QAPjP

8 2 Sample Identification

Samples shall be labeled and identified in accordance with Section 8 3 2 2 of the QAPjP and the SOPs in Table 1 Samples will have unique identification that traces the sample to the source(s) and indicates the media type (e g , GW for groundwater samples), the sequential number for the sample, the sampling contractor's identification, and the date Labels shall also include the method of sampling and the conditions prevailing at the time of sampling

8 3 Chain-of-Custody

Sample chain-of-custody will be maintained through the application of SOP 1 13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples, and as illustrated in Figure 8-1 of the QAPjP for all environmental samples collected during field investigations

9 0 CONTROL OF PROCESSES

The overall process of collecting samples, performing analysis, and inputting the data into a database is a process that requires control The process is controlled through a series of written procedures that govern and document the work activities The process is illustrated diagrammatically in Section 8 of the QAPjP

10 0 INSPECTION

Procured materials and construction activities (e g , groundwater monitoring well installation) shall be inspected (as applicable) in accordance with the requirements specified in Section 10 0 of the QAPjP and the installation specifications included in the OU-2 Bedrock Workplan and field sampling SOPs

11 0 TEST CONTROL

Test control requirements for borehole hydraulic conductivity tests (pump-in packer tests) will be controlled according to the requirements of SOP 2 3, Pump-In Borehole Packer Testing, and the test plan presented in Section 8 of the OU-2 Bedrock Workplan Test results will be documented as outlined in SOP 2 3

12 0 CONTROL OF MEASURING AND TEST EQUIPMENT (M&TE)

12 1 Field Equipment

Specific conductivity, temperature, and pH of groundwater samples shall be measured in the field Field measurements will be taken and the instruments calibrated as specified in SOP 2 5 (see Table 1) Measurements shall be made using the following equipment (or EG&G-approved alternates)

- Specific Conductivity HACH Conductivity Meter
- pH HACH pH Meter (this meter will also be used for temperature measurements)

- Temperature HACH pH Meter

Each piece of field equipment shall have a file that contains

- Operating instructions,
- Routine preventative maintenance instructions and schedules,
- Calibration methods, frequency, and description of the calibration solutions, and
- Standardization procedures (traceability to nationally recognized standards)

The above information shall, in general, conform to the manufacturer's recommended operating instructions or shall explain the deviation from said instructions

12 2 Laboratory Equipment

Laboratory analyses will be performed by contracted laboratories The equipment used to analyze environmental samples shall be calibrated, maintained, and controlled in accordance with the requirements contained in the specific analytical protocols used and the manufacturer's instructions Laboratories are required to submit calibration procedures to EG&G for review and approval Initial and continuing calibration data for analytical equipment used shall be included in the data packages submitted to EG&G by the laboratories

13 0 HANDLING, STORAGE, AND SHIPPING

Samples shall be packaged, transported, and stored in accordance with SOP 1 13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples Maximum sample holding times, sample preservative, sample volumes, and sample containers are specified in Table 8-1 of the QAPjP

EG&G will develop and implement an ER Department administrative procedure for receiving, handling, and storing construction materials (e g , well casing) to ensure only appropriate, accepted

materials are used and are handled and stored to prevent contamination or damage prior to use/installation

14 0 STATUS OF INSPECTION, TEST, AND OPERATIONS

The requirements for the identification of inspection, test, and operating status of items, products, systems, or equipment shall be implemented as specified in Section 14 0 of the QAPjP A log specifying the status of all boreholes and groundwater monitoring wells shall be maintained by the Field Activities Task Leader, which will include well/borehole identification number, geologic coordinates, ground elevation, casing depth of hole, depth to bedrock, static water level (as applicable), depth to top and bottom of screen (as applicable), diameter of hole, diameter of casing, and top/bottom of casing

The status of monitoring/test equipment will be maintained in a log directly traceable to the particular piece of equipment, and status indicator tags shall be attached to equipment where such a tag will not interfere with equipment operation

15 0 CONTROL OF NONCONFORMANCES

The requirements for the identification, control, evaluation, and disposition of nonconforming items, samples, and data will be implemented as specified in Section 15 0 of the QAPjP Nonconformances identified by the implementing contractor shall be submitted to the ER Department QA Program Manager (QAPM) for processing as outlined in the QAPjP

16 0 CORRECTIVE ACTION

The requirements for the identification, documentation, and verification of corrective actions for conditions adverse to quality will be implemented as outlined in Section 16 0 of the QAPjP Conditions adverse to quality identified by the implementing Contractor shall be documented and submitted to the ER Department QAPM for processing as outlined in the QAPjP

17 0 QUALITY ASSURANCE RECORDS

All field records, including field data records, scientific notebooks, drilling logs, etc , are considered QA records and shall be controlled in accordance with the SOP 1 2, Field Document Control QA records to be generated during OU-2 Bedrock Workplan activities include, but are not limited to

- Field Logs (e g , sample collection notebooks/logs for water, sediment, and air)
- Calibration Records
- Sample Collection and Chain-of-Custody Records
- Drilling Logs
- Work Plan/Field Sampling Plan
- QAPjP/QAA
- Audit/Surveillance/Inspection Reports
- Nonconformance Reports
- Corrective Action Documentation
- Data Validation Results
- Analytical Results
- Procurement/Contracting Documentation
- Training/Qualification Records
- Inspection Records

All QA records generated during the planning, implementation, and closure of the OU-2 Bedrock Workplan activities will be submitted to the ER Department Records Manager for processing and retention according to the QA records system described in Section 17 of the QAPjP

18 0 QUALITY VERIFICATION

The requirements for the verification of quality shall be implemented as specified in Section 18 0 of the QAPjP EG&G will conduct audits of the laboratory contractor as specified in the GRRASP (a minimum of two audits during sample analysis for OU-2 Bedrock Samples) The QAPM shall develop a surveillance schedule with the surveillance intervals based on the importance and

complexity of each activity sub-task Intervals will also be based on the schedule contained in Section 7 0 of the OU-2 Bedrock Workplan

Specific tasks that will be monitored by the surveillance program are as follows

- Borings and well installations (approximately 10% of the holes)
- Field Sampling (approximately 5% of each type of sample collected)
- Records Management (a surveillance will be conducted once at the initiation of OU-2 Phase II activities, and monthly thereafter)
- Data Verification, validation, and reporting

Audits of Contractors providing field investigation, construction, and analytical support services shall be performed at least annually or once during the life of the project, whichever is more frequent

19 0 SOFTWARE CONTROL

The requirements for software development and control shall be implemented as specified in Section 19 0 of the QAPjP Computer software utilized by Contractors will be furnished by EG&G. Only database and spreadsheet software will be used for the OU-2 Bedrock Workplan activities The procedure applicable to the use of the database that stores environmental data in the field is SOP 1 14, Field Data Management

APPENDIX A

Analytical Methods, Detection Limits, and Data Quality Objectives

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SUB SOIL	Required Detection Limits Water	Soil/Sed.	Precision Objective	Accuracy Objective
INDICATORS							
Total Suspended Solids	EPA 160 2[d]			10 mg/L	NA	20%RPD[f]	80-120% LCS Recovery
Total Dissolved Solids	EPA 160 1[d]	X[F]		5 mg/L	NA	20%RPD[f]	80-120% LCS Recovery
pH	EPA 150 1[d]	X[F]		0 1 pH units	0 1 pH units	NA	±0 05 pH units
INORGANICS							
Target Analyte List - Metals		X[F]	X			WATER/SOIL	WATER/SOIL
Aluminum	EPA CLP SOW[e]			200 ug/L[4]	40 mg/Kg[4]	**	***
Antimony	EPA CLP SOW[e]			60	12		
Arsenic (GFAA)	EPA CLP SOW[e]			10	2		
Barium	EPA CLP SOW[e]			200	40		
Beryllium	EPA CLP SOW[e]			5	1 0		
Cadmium	EPA CLP SOW[e]			5	1 0		
Calcium	EPA CLP SOW[e]			5000	2000		
Chromium	EPA CLP SOW[e]			10	2 0		
Cobalt	EPA CLP SOW[e]			50	10		
Copper	EPA CLP SOW[e]			25	5 0		
Cyanide	EPA 335 3 (modified for CLP)[e,d]			5	10		
Iron	EPA CLP SOW[e]			100 ug/L[4]	20 mg/Kg[4]		
Lead (GFAA)	EPA CLP SOW[e]			3	1 0		
Magnesium	EPA CLP SOW[e]			5000	2000		
Manganese	EPA CLP SOW[e]			15	3 0		
Mercury (CVAA)	EPA CLP SOW[e]			0 2	0 2		
Nickel	EPA CLP SOW[e]			40	8 0		
Potassium	EPA CLP SOW[e]			5000	2000		
Selenium (GFAA)	EPA CLP SOW[e]			5	1 0		
Silver	EPA CLP SOW[e]			10	2 0		
Sodium	EPA CLP SOW[e]			5000	2000		
Thallium (GFAA)	EPA CLP SOW[e]			10	2 0		
Vanadium	EPA CLP SOW[e]			50	10		
Zinc	EPA CLP SOW[e]			20	4 0		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil/Sed.	Precision Objective	Accuracy Objective
Other Metals		X[F]	X			WATER/SOIL	WATER/SOIL
Molybdenum	EPA CLP SOW[b] (ICAP)			8 ug/L[4]	40 mg/Kg[4]	**	***
Cesium	EPA CLP SOW[b]			1000	200		
Strontium	EPA CLP SOW[b]			200	40		
Lithium	EPA CLP SOW[b]			100	20		
Tin	EPA CLP SOW[b]			200	40		
Other Inorganics							
Percent Solids	EPA 160 3[d]		X	NA	10 mg	NA	NA
Sulfide	EPA 376 1[d]		X	NA	4 ug/g	Same as metals	Same as metals
ANIONS						Water/Soil	Water/Soil
Carbonate	EPA 310 1[d]	X[U]		10 mg/L	NA	Same as metals	Same as metals
Bicarbonate	EPA 310 1[d]	X[U]		10 mg/L	NA		
Chloride	EPA 325 2[d]	X[U]		5 mg/L	NA		
Sulfate	EPA 375 4[d]	X[U]		5 mg/L	NA		
Nitrate as N	EPA 353 2[d] or 353 3[d]	X[U]		1 mg/L	NA		
Fluoride	EPA 340 2[d]	X[U]		5 mg/L	NA		
Oil and Grease	EPA 413 2[d]			5 mg/L	NA	**	***
*Total Petroleum Hydrocarbons	EPA 418 1[d]		X	NA	10 mg/Kg	NA/40	NA/80-120
Target Compound List - Volatiles	EPA CLP SOW[c]	X[U]	X			WATER/SOIL	WATER/SOIL
Chloromethane	EPA CLP SOW[c]			10 ug/L	10 ug/Kg (low)[3]	**	***
Bromomethane	EPA CLP SOW[c]			10	10		
Vinyl Chloride	EPA CLP SOW[c]			10	10		
Chloroethane	EPA CLP SOW[c]			10	10		
Methylene Chloride	EPA CLP SOW[c]			5	5		
Acetone	EPA CLP SOW[c]			10	10		
Carbon Disulfide	EPA CLP SOW[c]			5	5		
1,1-Dichloroethene	EPA CLP SOW[c]			5	5		
1,1-Dichororethane	EPA CLP SOW[c]			5 ug/L	5 ug/Kg(low)[3]		
total 1,2-Dichloroethene	EPA CLP SOW[c]			5	5		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Soil/Sed.	Precision Objective	Accuracy Objective
Target Compound List - Volatiles (continued)		X[U]	X			WATER/SOIL	WATER/SOIL
Chloroform	EPA CLP SOW[c]			5	5	**	***
1,2-Dichloroethane	EPA CLP SOW[c]			1	5		
2-Butanone	EPA CLP SOW[c]			10	10		
1,1,1-Trichoroethane	EPA CLP SOW[c]			5	5		
Carbon Tetrachloride	EPA CLP SOW[c]			5	5		
Vinyl Acetate	EPA CLP SOW[c]			10	10		
Bromodichloromethane	EPA CLP SOW[c]			5	5		
1,2-Dichloropropane	EPA CLP SOW[c]			5	5		
cis-1,3-Dichloropropene	EPA CLP SOW[c]			5	5		
Trichloroethene	EPA CLP SOW[c]			5	5		
Dibromochloromethane	EPA CLP SOW[c]			5	5		
1,1,2-Trichloroethane	EPA CLP SOW[c]			5	5		
Benzene	EPA CLP SOW[c]			5	5		
trans-1,2-Dichloropropene	EPA CLP SOW[c]			5	5		
Bromoform	EPA CLP SOW[c]			5	5		
4-Methyl-2-pentanone	EPA CLP SOW[c]			10	10		
2-Hexanone	EPA CLP SOW[c]			10	10		
Tetrachloroethene	EPA CLP SOW[c]			5	5		
Toluene	EPA CLP SOW[c]			5	5		
1,1,2,2-Tetrachoroethane	EPA CLP SOW[c]			5	5		
Chlorobenzene	EPA CLP SOW[c]			5	5		
Ethyl Benzene	EPA CLP SOW[c]			5	5		
Styrene	EPA CLP SOW[c]			5	5		
Total Xylenes	EPA CLP SOW[c]			5	5		
Target Compound List - Semi-Volatiles		X[U]	X			WATER/SOIL	WATER/SOIL
Phenol	EPA CLP SOW[c]			10 ug/L	330 ug/Kg[3]	**	***
bis(2-Chloroethyl)ether	EPA CLP SOW[c]			10	330		
2-Chlorophenol	EPA CLP SOW[c]			10	330		
1,3-Dichlorobenzene	EPA CLP SOW[c]			10	330		
1,4-Dichlorobenzene	EPA CLP SOW[c]			10	330		
Benzyl Alcohol	EPA CLP SOW[c]			10	330		
1,2-Dichlorobenzene	EPA CLP SOW[c]			10	330		
2-Methylphenol	EPA CLP SOW[c]			10	330		
bis(2-Chloroisopropyl)ether	EPA CLP SOW[c]			10	330		
4-Methylphenol	EPA CLP SOW[c]			10	330		
N-Nitroso-Dipropylamine	EPA CLP SOW[c]			10	330		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil/Sed.	Precision Objective	Accuracy Objective
Target Compound List - Semi-Volatiles (continued)		X[U]	X			WATER/SOIL	WATER/SOIL
Hexachloroethane	EPA CLP SOW[C]			10	330	**	***
Nitrobenzene	EPA CLP SOW[C]			10	330		
Isophorone	EPA CLP SOW[C]			10	330		
2-Nitrophenol	EPA CLP SOW[C]			10	330		
2,4-Dimethylphenol	EPA CLP SOW[C]			10	330		
Benzoic Acid	EPA CLP SOW[C]			50	1600		
bis(2-Choroethoxy)methane	EPA CLP SOW[C]			10	330		
2,4-Dichlorophenol	EPA CLP SOW[C]			10	330		
1,2,4-Trichlorobenzene	EPA CLP SOW[C]			10	330		
Naphthalene	EPA CLP SOW[C]			10	330		
4-Chloroanaline	EPA CLP SOW[C]			10	330		
Hexachlorobutadiene	EPA CLP SOW[C]			10	330		
4 Chloro-3-methylphenol	EPA CLP SOW[C]			10	330		
2-Methylnaphthalene	EPA CLP SOW[C]			10	330		
Hexachlorocyclopentadiene	EPA CLP SOW[C]			10 ug/L	330 ug/Kg[3]		
2,4,6-Trichlorophenol	EPA CLP SOW[C]			10	330		
2,4,5-Trichlorophenol	EPA CLP SOW[C]			50	1600		
2-Chloronaphthalene	EPA CLP SOW[C]			10	330		
2-Nitroanaline	EPA CLP SOW[C]			50	1600		
Dimethylphthalate	EPA CLP SOW[C]			10	330		
Acenaphthylene	EPA CLP SOW[C]			10	330		
2,6-Dinitrotoluene	EPA CLP SOW[C]			10	330		
3-Nitroaniline	EPA CLP SOW[C]			50	1600		
Acenaphthene	EPA CLP SOW[C]			10	330		
2,4-Dinitrophenol	EPA CLP SOW[C]			50	1600		
4-Nitrophenol	EPA CLP SOW[C]			50	1600		
Dibenzofuran	EPA CLP SOW[C]			10	330		
2,4-Dinitrotoluene	EPA CLP SOW[C]			10	330		
Diethylphthalate	EPA CLP SOW[C]			10	330		
4-Chlorophenol Phenyl ether	EPA CLP SOW[C]			10	330		
Fluorene	EPA CLP SOW[C]			10	330		
4-Nitroanaline	EPA CLP SOW[C]			50	1600		
4,6-Dinitro-2-methylphenol	EPA CLP SOW[C]			50	1600		
N-nitrosodiphenylamine	EPA CLP SOW[C]			10	330		
4-Bromophenyl Phenyl ether	EPA CLP SOW[C]			10	330		
Hexachlorobenzene	EPA CLP SOW[C]			10	330		
Pentachlorophenol	EPA CLP SOW[C]			50	1600		
Phenanthrene	EPA CLP SOW[C]			10	330		
Anthracene	EPA CLP SOW[C]			10 ug/L	330 ug/Kg[3]		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Soil/Sed.	Precision Objective	Accuracy Objective
Target Compound List - Semi-Volatiles (continued)		X[U]	X			WATER/SOIL	WATER/SOIL
Di-n-butylphthalate	EPA CLP SOW[C]			10	330	**	***
Fluoranthene	EPA CLP SOW[C]			10	330		
Pyrene	EPA CLP SOW[C]			10	330		
Butyl Benzylphthalate	EPA CLP SOW[C]			10	330		
3,3'-Dichlorobenzidine	EPA CLP SOW[C]			20	660		
Benzo(a)anthracene	EPA CLP SOW[C]			10	330		
Chrysene	EPA CLP SOW[C]			10	330		
bis(2-ethylhexyl)phthalate	EPA CLP SOW[C]			10	330		
Di-n-octyl Phthalate	EPA CLP SOW[C]			10	330		
Benzo(b)fluoranthene	EPA CLP SOW[C]			10	330		
Benzo(k)fluoranthene	EPA CLP SOW[C]			10	330		
Benzo(a)pyrene	EPA CLP SOW[C]			10	330		
Indeno(1,2,3-cd)pyrene	EPA CLP SOW[C]			10	330		
Dibenz(a,h)anthracene	EPA CLP SOW[C]			10	330		
Benzo(g,h,i)perylene	EPA CLP SOW[C]			10	330		
Target Compound List - Pesticides/PCBs		X[U]	X			WATER/SOIL (%RPD)	WATER/SOIL (% Recovery)
alpha-BHC	EPA CLP SOW[C]			0 05 ug/L	8 0 ug/Kg[3]	**	***
beta-BHC	EPA CLP SOW[C]			0 05	8 0		
delta-BHC	EPA CLP SOW[C]			0 05	8 0		
gamma-BHC (Lindane)	EPA CLP SOW[C]			0 05	8 0		
Heptachlor	EPA CLP SOW[C]			0 05	8 0		
Aldrin	EPA CLP SOW[C]			0 05 ug/L	8 0 ug/Kg[3]		
Heptachlor Epoxide	EPA CLP SOW[C]			0 05	8 0		
Endosulfan I	EPA CLP SOW[C]			0 05	8 0		
Dieldrin	EPA CLP SOW[C]			0 10	16 0		
4,4'-DDE	EPA CLP SOW[C]			0 10	16 0		
Endrin	EPA CLP SOW[C]			0 10	16 0		
Endosulfan II	EPA CLP SOW[C]			0 10	16 0		
4,4'-DDD	EPA CLP SOW[C]			0 10	16 0		
Endosulfan Sulfate	EPA CLP SOW[C]			0 10	16 0		
4,4'-DDT	EPA CLP SOW[C]			0 10	16 0		
Methoxychlor	EPA CLP SOW[C]			0 5	80 0		
Endrin Ketone	EPA CLP SOW[C]			0 10	16 0		
alpha-Chlordane	EPA CLP SOW[C]			0.5	80 0		
gamma-Chlordane	EPA CLP SOW[C]			0 5	80 0		
Toxaphene	EPA CLP SOW[C]			1 0	160 0		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Required Detection Limits Water	Required Detection Limits Soil/Sed.	Precision Objective	Accuracy Objective
Target Compound List - Pesticides/PCBs (continued)		X[U]	X			WATER/SOIL (%RPD)	WATER/SOIL (% Recovery)
AROCLOR-1016	EPA CLP SOW[c]			0 5	80 0	**	***
AROCLOR-1221	EPA CLP SOW[c]			0 5	80 0		
AROCLOR-1232	EPA CLP SOW[c]			0 5	80 0		
AROCLOR-1242	EPA CLP SOW[c]			0 5	80 0		
AROCLOR-1248	EPA CLP SOW[c]			0 5	80 0		
AROCLOR-1254	EPA CLP SOW[c]			1 0	160 0		
AROCLOR-1260	EPA CLP SOW[c]			1 0	160 0		
RADIONUCLIDES						(Replicate Analyses)	(Laboratory Control Sample)
Gross Alpha	s,f,g,h,i,k,l,m,n	X[F]	X	2 pCi/L	4 pCi/g	**	***
Gross Beta	s,f,g,h,i,k,l,m,n	X[F]	X	4 pCi/L	10 pCi/g		
Uranium 233+234	f,h,i,m,n,s,l	X[F]	X	0 6 pCi/L	0 3 pCi/g		
Uranium 235,238	f,h,i,m,n,s,l	X[F]	X	0 6 pCi/L	0 3 pCi/g		
Americium 241	p,q,s,l,i	X[F]	X	0 01 pCi/L	0 02 pCi/g		
Plutonium 239+240	o,p,s,l,i	X[F]	X	0 01 pCi/L	0 03 pCi/g		
Tritium	f,g,h,m,s,l	X[U]	X	400 pCi/L	400 pCi/L		
Strontium 89,90	f,h,i,m,s,l		X	NA	1 pCi/g		
Strontium 90 only	f,h,i,m,s,l	X[F]		1 pCi/L	NA		
Cesium 137	i,m,l,h	X[F]	X	1 pCi/L	0 1 pCi/g		
Radium 226	i,f,g,h,m[5],s,l	X[F]		0 5 pCi/L	0 5 pCi/g		
Radium 228	i,f,g,h,m[5],s,l	X[F]		1 pCi/L	0 5 pCi/g		

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

Analyte	Method	GW	SOIL	Readability Objective	Accuracy
FIELD PARAMETERS					
pH	1	X		± 0 1 pH unit	± 0 2 pH units
Specific Conductance	1	X		2 5 umho/cm[7] 25 umho/cm[8] 250 umho/cm[8]	± 2 5% max error at 500, 5000, 50000 umhos/cm plus probe, ± 3 0% max error at 250, 2500, and 25000 plus probe accuracy of ± 2 0%
Temperature	1	X		± 0 1°C	± 1 0°C
Dissolved Oxygen	1			± 0 1 mg/L	± 10%

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

* For samples collected from IHSSs 102 and 105 only [BH01,BH02,BH03,BH04,BH05,BH06,BH07,BH08 (MW33),BH09,BH15,BH16,BH17,BH18,MW01,MW02,MW03,MW33 (BH08)]
** Precision objective = control limits specified in referenced method and/or Data Validation Guidelines
*** Accuracy objective = control limits specified in referenced method (in GRRASP for radionuclides)
F = Filtered
U = Unfiltered
1 Measured in the field in accordance with instrument manufacturer's instructions The instruments to be used are specified in Section 12
2 Medium soil/sediment required detection limits for pesticide/PCB TCL compounds are 15 times the individual low soil/sediment required detection limit
3 Detection limits listed for soil/sediment are based on wet weight The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher
4 Higher detection limits may only be used in the following circumstance If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the required detection limit This is illustrated in the example below

For lead

Method in use - ICP
Instrument Detection Limit (IDL) - 40
Sample Concentration - 220
Required Detection Limit (RDL) - 3

The value of 220 may be reported even though the instrument detection limit is greater than the RDL

Note The specified detection limits are based on a pure water matrix. The detection limits for samples may be considerably higher depending on the sample matrix
5 If gross alpha > 5 pCi/L, analyze for Radium 226, if Radium 226 > 3 pCi/L, analyze for Radium 228
6 The detection limits presented were calculated using the formula in N R C Regulatory Guide 4 14, Appendix Lower Limit of Detection, pg 21, and follow

$$LLD = \frac{4\ 66\ (BKG/BKG\ DUR)^{1/2}}{(2\ 22)(Eff)(CR)(SR)(e^{-\lambda t})(Aliq)}$$

$$MDA = \frac{4\ 66\ (BKG/Sample\ DUR)^{1/2}}{(2\ 22)(Eff)(CR)(SR)e^{-\lambda t}(Aliq)}$$

Where

LLD = Lower Limit of Detection in pCi per sample unit
BKG = Instrument Background in counts per minute (CPM)
Eff = Counting efficiency in cpm/disintegration per minute (dpm)
CR = Fractional radiochemical yield
SR = Fractional radiochemical yield of a known solution
λ = The radioactive decay constant for the particular radionuclide
t = The elapsed time between sample collection and counting
Aliq = Sample volume
BKG DUR = Background count duration in minutes

MDA = Minimum Detectable Activity in pCi per sample unit
BKG = same as for LLD
Eff = same as for LLD
CR = same as for LLD
SR = same as for LLD
λ = same as for LLD
t = same as for LLD
Aliq = same as for LLD
Sample DUR = sample count duration in minutes

ANALYTICAL METHODS, DETECTION LIMITS, AND DATA QUALITY OBJECTIVES

7 On 500 umho/cm range
8 On 5000 umho/cm range
9 On 50000 umho/cm range
a U S Environmental Protection Agency Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, 7/88 (or latest version)
b U S Environmental Protection Agency Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, 7/88 (or latest version) The specific method to be utilized is at the laboratory's discretion provided it meets the specified detection limit
c U S Environmental Protection Agency Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, 2/88 (or latest version)
d Methods are from "Methods for Chemical Analysis of Water and Wastes," U S Environmental Protection Agency, 1983, unless otherwise indicated
e Methods are from "Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods," (SW-846, 3rd Ed), U S Environmental Protection Agency
f U S Environmental Protection Agency, 1979, Radiochemical Analytical Procedures for Analysis of Environmental Samples, Report No EMSL-LV-0539-1, Las Vegas, NV, U S Environmental Protection Agency
g American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985 Standard Methods for the Examination of Water and Wastewater, 16th ed , Washington, D C , Am Public Health Association
h U S Environmental Protection Agency, 1976 Interim Radiochemical Methodology for Drinking Water, Report No EPA-600/4-75-008 Cincinnati U S Environmental Protection Agency
i Harley, J H , ed , 1975, ASL Procedures Manual, HASL-300, Washington, D C , U S Energy Research and Development Administration
j US EPA, 1982 "Methods for Organic Analysis of Municipal and Industrial Waste Water "
k "Handbook of Analytical Procedures," USAEC, Grand Junction Lab 1970, page 196
l "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, August 1980, Environmental Monitoring and Support Laboratory, Office of Research and Development, U S Environmental Protection Agency, Cincinnati, Ohio 45268
m "Methods for Determination of Radioactive Substances in Water and Fluvial Sediments," U S G S Book 5, Chapter A5, 1977
n "Acid Dissolution Method for the Analysis of Plutonium in Soil," EPA-600/7-79-081, March 1979, U S EPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, 1979
o "Procedures for the Isolation of Alpha Spectrometrically Pure Plutonium, Uranium, and Americium," by E H Essington and B J Drennon, Los Alamos National Laboratory, a private communication
p "Isolation of Americium from Urine Samples," Rocky Flats Plant, Health, Safety, and Environmental Laboratories
q "Radioactivity in Drinking Water," EPA 570/9-81-002
r If the sample or duplicate result is <5 x IDL, then the control limit is ± IDL
s US EPA, 1987, Eastern Environmental Radiation Facility Radiochemistry Procedures Manual, EPA-520/5-84-006